

APPENDIX F.

Business Ownership in the Arizona Construction and Engineering Industries

Almost one in five construction workers in Arizona was a self-employed business owner in 2008-2012. One in eight workers in the local engineering industry was a self-employed business owner. Focusing on construction and engineering, Keen Independent examined business ownership for different racial/ethnic and gender groups in Arizona using Public Use Microdata Samples (PUMS) from the 2000 Census and from the 2008-2012 American Community Survey (ACS). (Appendix F uses “self-employment” and “business ownership” interchangeably.)

Business Ownership Rates

Many studies have explored differences between minority and non-minority business ownership at the national level.¹ Although self-employment rates have increased for minorities and women over time, a number of studies indicate that race, ethnicity and gender continue to affect opportunities for business ownership. The extent to which such individual characteristics may limit business ownership opportunities differs across industries and from state to state.

Construction industry. Keen Independent classified workers as self-employed if they reported that they worked in their own unincorporated or incorporated business. In 2008-2012, 19 percent of workers in the Arizona construction industry were self-employed compared with 9 percent of workers across all industries.

Rates of self-employment in the Arizona construction industry vary by race, ethnicity and gender. Figure F-1 shows the percentage of workers who were self-employed in the construction industry by group for 2000 and 2008-2012 in Arizona.

¹ See, for example, Waldinger, Roger and Howard E. Aldrich. 1990. Ethnicity and Entrepreneurship. *Annual Review of Sociology*. 111-135.; Fairlie, Robert W. and Bruce D. Meyer. 1996. *Ethnic and Racial Self-Employment Differences and Possible Explanations*. The Journal of Human Resources, Volume 31, Issue 4, 757-793.; Fairlie, Robert W. and Alicia M. Robb. 2007. *Why are Black-Owned Businesses Less Successful than White-Owned Businesses? The Role of Families, Inheritances and Business Human Capital*. Journal of Labor Economics, 25(2), 289-323.; and Fairlie, Robert W. and Alicia M. Robb. 2006. *Race, Families and Business Success: A Comparison of African-American-, Asian-, and White-Owned Businesses*. Russell Sage Foundation.

Figure F-1.
Percentage of workers in the construction industry who were self-employed,
2008-2012 and 2000

Arizona	2008-2012	2000
Race/ethnicity		
African American	14.2 % **	9.6 % **
Asian American	18.4	16.0
Hispanic American	13.4 **	8.6 **
Native American or other minority	6.3 **	7.0 **
Non-Hispanic white	24.8	22.2
Gender		
Female	18.8 %	14.6 % **
Male	19.2	17.0
All individuals	19.1 %	16.7 %

Note: *, ** Denote that the difference in proportions between the minority and non-Hispanic white groups (or female and male groups) for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

Business ownership rates in 2000. In 2000, 22 percent of non-Hispanic whites were self-employed. Business ownership rates were less than half of that rate for African Americans, Hispanic Americans and Native Americans (statistically significant differences).

- About 10 percent of African Americans working in the Arizona construction industry owned businesses.
- About 9 percent of Hispanic Americans in the construction industry owned businesses.
- The ownership rate of Native Americans and other minorities in the construction industry was 7 percent, one-third of the rate for non-Hispanic whites.

The Asian American self-employment rate in the construction industry was 16 percent. The difference between this rate and that of non-Hispanic whites in the Arizona construction industry was not statistically significant due to the small sample size for Asian American construction workers in Arizona.

In 2000, there were also differences in business ownership rates between men and women working in the industry. Seventeen percent of men in the Arizona construction industry owned businesses and about 15 percent of women owned businesses in 2000, a statistically significant difference.

Business ownership in 2008-2012. In 2008-2012, business ownership rates in the Arizona construction industry were higher among non-Hispanic whites and each minority group except for Native Americans. Women made gains in self-employment from 2000 to 2008-2012.

In 2008-2012, disparities in business ownership rates persisted between non-Hispanic whites (25%) and minority groups:

- Business ownership among Hispanic Americans in the construction industry increased to 13 percent in 2008-2012; the difference in ownership rates from non-Hispanic whites remained statistically significant.
- Business ownership among African Americans in the Arizona construction industry increased to 14 percent in 2008-2012 but remained statistically different compared with non-Hispanic whites.
- About 6 percent of Native Americans and other minorities in the construction industry in 2008-2012 were self-employed. The business ownership rate for this group was less than one-third of the rate for non-Hispanic whites (statistically significant difference).

The business ownership rate for women increased to about 19 percent for 2008-2012, on par with the rate for men (19%).

Engineering industry. Keen Independent also examined business ownership rates in the Arizona engineering industry. Figure F-2 presents the percentage of workers who were self-employed in the engineering industry in 2000 and 2008-2012.

Figure F-2.
Percentage of workers in the engineering industry who were self-employed,
2000 and 2008-2012

Arizona	2008-2012	2000
Race/ethnicity		
African American	0.0 % **	21.4 %
Asian American	7.6 **	8.7 *
Hispanic American	5.9 **	13.9
Native American or other minority	6.7	9.7
Non-Hispanic white	15.3	17.3
Gender		
Female	11.6 %	9.4 % **
Male	13.4	19.0
All individuals	13.0 %	16.6 %

Note: *, ** Denote that the difference in proportions between the minority and non-Hispanic white groups (or female and male groups) for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

As shown in Figure F-2, business ownership for workers in the engineering industry declined from 2000 to 2008-2012. Business ownership rates decreased for each minority group as well as non-Hispanic whites. Women were the only group to recognize gains in self-employment during this period.

In the Arizona engineering industry in 2008-2012, there were statistically significant disparities for three minority groups, as discussed below:

- There were no self-employed African Americans in the sample data for the engineering industry in 2008-2012, so the calculated business ownership rate for that group was 0 percent.
- The business ownership rate for Hispanic Americans was about 6 percent, less than half the rate non-Hispanic whites (15%).
- The rate for Asian Americans was about 8 percent in 2008-2012. Asian Americans were self-employed at about half the rate of non-Hispanic whites.

Although Native Americans also had a low self-employment rate in this industry in 2008-2012 (7%), the difference in rates from non-Hispanic whites was not statistically significant. This may be due to the small number of this group in the sample of workers in the engineering industry in Arizona.

Figure F-2 also compares business ownership rates for women and men working in the Arizona engineering industry. For 2008 to 2012, about 12 percent of women in the engineering industry were self-employed while business ownership among men fell to 13 percent. This closing of the gap among men and women removed any statistical difference.

Potential causes of differences in business ownership rates. Nationally, researchers have examined whether there are disparities in business ownership rates after considering personal characteristics such as education and age. Several studies have found that disparities in business ownership still exist even after accounting for such factors.

- **Financial capital.** Some studies have concluded that access to financial capital is a strong determinant of business ownership. Researchers have consistently found a positive relationship between startup capital and business formation, expansion, and survival.² In addition, one study found that housing appreciation measured at the Metropolitan Statistical Area level is a positive determinant of becoming self-employed.³ However, unexplained differences still exist when statistically controlling for those factors.⁴ Access to capital is discussed in more detail in Appendix G.
- **Education.** Education has a positive effect on the probability of business ownership in most industries. However, results of multiple studies indicate that minorities are still less likely to own

² See Lofstrom, Magnus and Chunbei Wang. 2006. *Hispanic Self-Employment: A Dynamic Analysis of Business Ownership*. Working paper, Forschungsinstitut zur Zukunft der Arbeit (Institute for the Study of Labor).; and Fairlie, Robert W. and Alicia M. Robb. 2006. *Race, Families and Business Success: A Comparison of African-American-, Asian-, and White-Owned Businesses*. Russell Sage Foundation.

³ Fairlie, Robert W. and Harry A. Krashinsky. 2006. *Liquidity Constraints, Household Wealth and Entrepreneurship Revisited*.

⁴ Lofstrom, Magnus and Chunbei Wang. 2006. *Hispanic Self-Employment: A Dynamic Analysis of Business Ownership*. Working paper, Forschungsinstitut zur Zukunft der Arbeit (Institute for the Study of Labor).

a business than non-minorities with similar levels of education.⁵ Recent research confirms a significant relationship between education and ability to obtain startup capital.⁶

- **Intergenerational links.** Intergenerational links affect one's likelihood of self-employment. One study found that experience working for a self-employed family member increases the likelihood of business ownership for minorities.⁷
- **Immigration to the United States.** Time since immigration and assimilation into American society are also important determinants of self-employment, but unexplained differences in business ownership between minorities and non-minorities still exist when accounting for those factors.⁸

Business Ownership Regression Analysis

Race/ethnicity and gender can affect opportunities for business ownership, even when accounting for personal characteristics such as education, age, and familial status. Recent research using data from 2007 through 2010 indicates minorities (including African Americans and Hispanic Americans) face greater credit constraints at business startup and throughout business ownership than non-Hispanic whites even after controlling for other factors including credit score.⁹

To further examine business ownership, Keen Independent developed multivariate regression models to explore patterns of business ownership in Arizona. Those models estimate the effect of race/ethnicity and gender on the probability of business ownership while statistically controlling for other personal and family characteristics.

An extensive body of literature examines whether race- and gender-neutral personal factors such as access to financial capital, education, age, and family characteristics (e.g., marital status) help explain differences in business ownership. That subject has also been examined in other disparity studies. For example, prior studies in Minnesota and Illinois have used econometric analyses to investigate whether disparities in business ownership for minorities and women working in the construction and engineering industries persist after statistically controlling for race- and gender-neutral personal characteristics.^{10, 11} Those studies have incorporated probit econometric models using PUMS data

⁵ See Fairlie, Robert W. and Bruce D. Meyer. 1996. *Ethnic and Racial Self-Employment Differences and Possible Explanations*. The Journal of Human Resources, Volume 31, Issue 4, 757-793; and Butler, John Sibley and Cedric Herring. 1991. *Ethnicity and Entrepreneurship in America: Toward an Explanation of Racial and Ethnic Group Variations in Self-Employment*. Sociological Perspectives. 79-94.

⁶ Robb, Alicia, Fairlie, Robert w. and Robinson, David T. 2009. "Capital Injections among New Black and White Business Ventures: Evidence from the Kauffman Firm Survey." Working Paper. Federal Reserve Bank of Cleveland.

⁷ See Fairlie, Robert W. and Alicia M. Robb. 2006. *Race, Families and Business Success: A Comparison of African-American-, Asian-, and White-Owned Businesses*. Russell Sage Foundation; and Fairlie, Robert W. and Alicia M. Robb. 2007. *Why are Black-Owned Businesses Less Successful than White-Owned Businesses? The Role of Families, Inheritances and Business Human Capital*. Journal of Labor Economics, 25(2), 289-323.

⁸ See Fairlie, Robert W. and Bruce D. Meyer. 1996. *Ethnic and Racial Self-Employment Differences and Possible Explanations*. The Journal of Human Resources, Volume 31, Issue 4, 757-793; and Butler, John Sibley and Cedric Herring. 1991. *Ethnicity and Entrepreneurship in America: Toward an Explanation of Racial and Ethnic Group Variations in Self-Employment*. Sociological Perspectives. 79-94.

⁹ Robb, Alicia. 2012. "Access to Capital among Young Firms, Minority-owned Firms, Women-owned Firms and High-Tech Firms." Small Business Administration.

¹⁰ National Economic Research Associates, Inc. 2000. *Disadvantaged Business Enterprise Availability Study*. Prepared for the Minnesota Department of Transportation.

from the 2000 Census and have been among the materials that agencies have submitted to courts in subsequent litigation concerning the implementation of the Federal DBE Program.

Keen Independent used similar probit regression models to predict business ownership from multiple independent or “explanatory” variables, such as:¹²

- Personal characteristics that are potentially linked to the likelihood of business ownership — age, age-squared, disability, marital status, number of children in the household, number of elderly people in the household, and English-speaking ability;
- Educational attainment;
- Measures and indicators related to personal financial resources and constraints — home ownership, home value, monthly mortgage payment, dividend and interest income, and additional household income from a spouse or unmarried partner; and
- Race, ethnicity and gender.

Keen Independent developed two probit regression models using PUMS data from the 2008-2012 ACS:

- A model for the Arizona construction industry that included 10,686 observations; and
- A model for the Arizona engineering industry that included 1,729 observations.

Arizona construction industry in 2008-2012. Figure F-3 presents the coefficients for the probit model for individuals working in the Arizona construction industry in 2008-2012. Several factors were important and statistically significant in predicting the probability of business ownership:

- Older workers were associated with a *higher* probability of business ownership;
- Higher home values were associated with a *higher* probability of business ownership;
- Greater interest and dividend income was associated with a *higher* probability of business ownership;
- Greater spousal or partner income was associated with a *lower* probability of business ownership;
- Speaking English well was associated with a *higher* likelihood of business ownership; and
- A higher level of educational attainment (advanced degree) was associated with a *higher* likelihood of business ownership.

¹¹ National Economic Research Associates, Inc. 2004. *Disadvantaged Business Enterprise Availability Study*. Prepared for the Illinois Department of Transportation.

¹² Probit models estimate the effects of multiple independent or “predictor” variables in terms of a single, dichotomous dependent or “outcome” variable — in this case, business ownership. The dependent variable is binary, coded as “1” for individuals in a particular industry who are self-employed and “0” for individuals who are not self-employed. The model enables estimation of the probability that workers in a given sample are self-employed, based on their individual characteristics. Keen Independent excluded observations where the Census Bureau had imputed values for the dependent variable (business ownership).

After statistically controlling for factors other than race and gender, there were statistically significant disparities in business ownership rates for African Americans, Hispanic Americans, Native Americans and women working in the Arizona construction industry. Members of these minority groups and women working in the Arizona construction industry were less likely to own construction businesses than similarly-situated non-minorities or men. The differences due to race, ethnicity or gender were greatest for African Americans and Native Americans and smaller for Hispanic Americans and women.

Figure F-3.
Arizona construction industry
business ownership model, 2008-
2012

Note:

*, ** Denote statistical significance at the 90% and 95% confidence levels, respectively.

Source:

Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 ACS raw data extract was obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

Variable	Coefficient
Constant	-2.6773 **
Age	0.0612 **
Age-squared	-0.0005 **
Married	0.0319
Disabled	0.0620
Number of children in household	0.0078
Number of people over 65 in household	-0.0115
Owns home	-0.0631
Home value (\$0,000s)	0.0007 **
Monthly mortgage payment (\$0,000s)	0.0190
Interest and dividend income (\$0,000s)	0.0067 **
Income of spouse or partner (\$0,000s)	-0.0018 **
Speaks English well	0.1504 **
Less than high school education	-0.0300
Some college	0.0611
Four-year degree	0.0028
Advanced degree	0.1860 *
African American	-0.3005 *
Asian-Pacific American	-0.0723
Subcontinent Asian American	-0.5522
Hispanic American	-0.2004 **
Native American	-0.7496 **
Other Minority	0.1907
Female	-0.1762 **

Simulations of business ownership rates. Probit modeling allows for further analysis of the disparities identified in business ownership rates for African Americans, Hispanic American, Native Americans and non-Hispanic white women. Keen Independent modeled business ownership rates for these groups as if they had the same probability of business ownership as similarly situated non-Hispanic white males. To conduct those simulations, Keen Independent took the following steps:

1. Keen Independent performed a probit regression analysis predicting business ownership using only non-Hispanic white male construction workers in the dataset.¹³
2. After obtaining the results from the non-Hispanic white male regression model, the study team coefficients from that model and the mean personal, financial, and educational characteristics of African American, Hispanic American, Native American and non-Hispanic white women working in the Arizona construction industry (i.e., indicators of educational attainment as well as indicators of personal financial resources and constraints) to estimate the probability of business ownership of each group.

Similar simulation approaches have been used in other disparity studies that courts have reviewed.

Figure F-4 presents the simulated business ownership rate (i.e., “benchmark” rate) for African Americans, Hispanic Americans Native Americans and non-Hispanic white women and compares it to the actual, observed mean probabilities of business ownership for that group. The disparity index was calculated by taking the actual business ownership rate for each group, dividing it by that group’s benchmark rate and then multiplying the result by 100. The disparity index expresses the presence of an ownership disparity, or lack thereof, in terms of what would be expected based on the simulated business ownership rates of similarly-situated non-Hispanic white male construction workers. Note that the “actual” self-employment rates are for the dataset used for these regression analyses and do not always exactly match results from the entire 2008-2012 data.

Results from these analyses show lower actual self-employment rates for African Americans, Native Americans and non-Hispanic white women than the simulated ownership rates for these groups:

- **African Americans.** The actual ownership rate for African American workers in the construction industry was 14.2 percent, less than the benchmark rate of 18.4 percent. Dividing 14.2 percent by 18.4 percent (and then multiplying by 100) gives a disparity index for African American business ownership of 77. Because the index is less than 100, the results indicate a disparity. Because it is less than 80, it indicates a “substantial” disparity (Appendix B has a discussion of the use of substantial disparity in court cases). In other words, African Americans owned businesses at about three-fourths the rate that would be expected based on simulated ownership rates of non-Hispanic white male construction workers.

¹³ That version of the model excluded the race/ethnicity and gender indicator variables, because the value of all of those variables would be the same (i.e., 0).

- **Native Americans.** The actual business ownership rate for Native Americans was 5.7 percent, less than the benchmark rate of about 17 percent. The corresponding disparity index was 33, indicating Native Americans owned construction businesses at about one-third of the rate that would be expected based on simulated ownership rates of non-Hispanic white males. This indicates a substantial disparity in the business ownership rates for Native Americans working in the Arizona construction industry.
- **Women.** The benchmark ownership rate for non-Hispanic white women was 25 percent and the corresponding disparity index was 84, indicating business ownership for non-Hispanic white women in the construction industry was about 84 percent of the rate that would be expected based on simulated rates of non-Hispanic white males..

The benchmark ownership rate for Hispanic American workers in the construction industry was 11.5 percent compared to the actual rate of about 13 percent, indicating that the business ownership rate for Hispanic Americans was higher than the rate that would be expected based on simulated ownership rates of non-Hispanic white males.

There may be several reasons for this outcome for Hispanic Americans. Among the non-Hispanic white males in the construction industry sample, more than 99 percent spoke English well, compared to two-thirds of Hispanic Americans in the construction industry sample. Fourteen percent of the non-Hispanic white male construction workers in the sample had obtained a four-year degree or more while only 3 percent of Hispanic American construction workers in the sample had the same level of education. Further, almost half of the Hispanic American construction workers in the sample had not graduated from high school compared with 12 percent for non-Hispanic white male construction workers in the sample.

Figure F-4.
Comparison of actual business ownership rates to simulated rates for
Arizona construction workers, 2008-2012

Group	Self-employment rate		Disparity index (100 = parity)
	Actual	Benchmark	
African American	14.2%	18.4%	77
Hispanic American	13.4%	11.5%	116
Native American	5.7%	17.3%	33
Non-Hispanic white female	21.0%	25.0%	84

Note: As the benchmark figure can only be estimated for records with an observed (rather than imputed) dependent variable, comparison is made with only this subset of the sample. For this reason, actual self-employment rates may differ slightly from those in Figure F-1.

Source: Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 ACS raw data extract was obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

Arizona engineering industry in 2008 through 2012. Keen Independent developed a separate business ownership model for the Arizona engineering industry using 2008-2012 ACS data. Figure F-5 presents the coefficients from that probit model.¹⁴ After controlling for personal and family characteristics, there were statistically significant disparities in business ownership rates among people working in the Arizona engineering industry for:

- African Americans; and
- Hispanic Americans.

There were a few individuals identified as other minorities in the ACS data. There was a statistically significant disparity in business ownership rates for these individuals as well.

After statistically controlling certain other factors, gender did not appear to affect the likelihood of owning a business.

Figure F-5.
Arizona engineering industry business ownership model, 2008-2018

Note:

*, ** Denote statistical significance at the 90% and 95% confidence levels, respectively.

Source:

Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 ACS raw data extract was obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

Variable	Coefficient
Constant	-3.2468 **
Age	0.0499
Age-squared	-0.0001
Married	-0.1506
Disabled	-0.0608
Number of children in household	0.0743
Number of people over 65 in household	-0.0441
Owens home	-0.1489
Home value (\$0,000s)	0.0004
Monthly mortgage payment (\$0,000s)	0.0710
Interest and dividend income (\$0,000s)	0.0049 *
Income of spouse or partner (\$0,000s)	0.0011
Less than high school education	0.4113
Some college	-0.2168
Four-year degree	-0.0765
Advanced degree	-0.2901
African American	-4.3223 **
Asian-Pacific American	-0.3181
Subcontinent Asian American	-0.1042
Hispanic American	-0.3588 **
Native American	-0.3778
Other Minority	-4.0757 **
Female	-0.0346

¹⁴ Speaking English well was excluded from the engineering industry model because nearly every individual in the dataset spoke English well.

Simulations of business ownership rates. Using the same approach as for the construction industry, the study team simulated business ownership rates in the Arizona engineering industry. Figure F-6 presents actual and simulated (“benchmark”) business ownership rates for African Americans and Hispanic Americans in the Arizona engineering industry. (The number of other minorities in the construction sample was too small to perform the analysis for that group.)

- **African Americans.** There were no African American business owners in the engineering worker 2008-2012 sample data. The benchmark business ownership rate for African Americans was about 4 percent based on similarly situated non-Hispanic white males.¹⁵
- **Hispanic Americans.** The self-employment rate of Hispanic American engineering workers from 2008-2012 was about 6 percent. The benchmark rate during this period was about 4 percent based on simulated ownership rates of non-Hispanic white males and the corresponding disparity index was 145, indicating Hispanic American business ownership in the Arizona engineering industry was higher than the rate that would be expected based on simulated rates of non-Hispanic white males. This result also occurred for the construction industry; some of the same explanations may also apply for Hispanic Americans in the engineering business ownership simulation.

Figure F-6.
Comparison of actual business ownership rates to simulated rates for
Arizona workers in the engineering industry, 2008-2012

Group	Self-employment rate		Disparity index (100 = parity)
	Actual	Benchmark	
African American	0.0%	3.7%	0
Hispanic American	5.9%	4.1%	145

Note: As the benchmark figure can only be estimated for records with an observed (rather than imputed) dependent variable, comparison is made with only this subset of the sample. For this reason, actual self-employment rates may differ slightly from those in Figure F-2.

Source: Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 raw data extract was obtained through the IPUMS program of the MN Population Center: <http://usa.ipums.org/usa/>.

¹⁵ The calculation of the disparity index is applicable in this case.

Summary of Business Ownership in the Construction and Engineering Industries

Disparities in business ownership were present in the Arizona construction industry:

- In both the 2000 and 2008-2012 time periods, business ownership rates for African Americans, Hispanic Americans and Native Americans were substantially lower than that of non-Hispanic whites. Business ownership rates were lower for women in 2000 but not in 2008-2012.
- After statistically controlling for a number of other factors affecting business ownership, statistically significant disparities in business ownership rates were identified for African Americans, Hispanic American, Native Americans and women working in the local construction industry in 2008-2012.

There were also disparities in business ownership in the Arizona engineering industry:

- Compared to non-Hispanic whites, business ownership rates were lower for African Americans, Asian Americans and Hispanic Americans in 2008-2012, and those differences were statistically significant.
- Using regression analysis to account for other personal characteristics, there were substantial disparities for African Americans and Hispanic Americans in 2008-2012.

Regression analysis indicated similar rates of business ownership for women and men in the Arizona engineering industry after controlling for other personal characteristics.